

DRAFT

REPORT TO CONGRESS

IV. Alternatives to PTC

Introduction

The railroad industry's reluctance to a long-term commitment of resources to develop a PTC system for widespread utilization has given rise to exploring less costly means of achieving a higher degree of command and control of train movements. The options for other than PTC to increase safety of train operations include utilization of emerging communications-based technology with less robustness; expansion of conventional train control technology or innovative developments of limited benefit. Emerging technology of reduced robustness include proximity warning systems with a variety of features. Automatic cab signals, automatic train stop and automatic train control systems have long been employed in the safest of rail corridors. Innovative developments are applied to address specific safety concerns.

Proximity Warning Systems

The proximity warning system was originally developed to provide information to train crew members concerning the presence of other trains within 3 to 7 miles. Subsequently, features requiring acknowledgment of the presence of other trains was added which created a communications-based trainstop system. When the presence of another train is detected nearby, acknowledgment by the engineer is required to prevent, or forestall, an application of the brakes until the train is brought to a stop. After acknowledging, it is dependent upon the engineer to properly control the speed of the train and to stop where a stop is required. These systems do not require extensive wayside communications links and are being investigated as a low cost alternative to PTC.

PTC-type enhancements are being explored in connection with the proximity warning systems under development. These enhancements include location determination systems that precisely locate trains; civil speed enforcement; and calculation of safe braking distances. Enforcement of the safe braking distances, civil and temporary speed restrictions will be necessary if the proximity warning systems are to meet the RSAC core objectives: collision avoidance, overspeed prevention and protection of maintenance-of-way employees.

Two proximity warning systems are under development - the BNSF's Train Guard™ and the Norfolk Southern's Location System (NSLS). Train Guard™ utilizes an on board track database in which the locations of civil speed restrictions, signal locations and other data are identified for enforcement purposes. Provisions for warnings concerning work zones of maintenance-of-way employees are being investigated. The engineer will be depended upon to manually input temporary speed restrictions into Train Guard™. Similar data in the NSLS is obtained from transponders embedded in the roadway. NSLS will not enforce temporary speed restrictions. Both systems utilize EOT frequencies to broadcast and receive train location data. The two systems are not interoperable and neither will enforce the limits of authority granted in mandatory directives.

However, the proximity warning systems represent the basic elements of a building block approach for the incremental development of PTC systems having capability of enforcing absolute stop where stop is required and enforcement of all speeds including temporary speed restrictions. The characteristics of trainstop and enforcement of civil speeds contained in the proximity warning systems would raise the level of safety above that presently achieved in operations by signal indications or mandatory directives but would not achieve the level of safety equal to PTC. Possible drawbacks of this approach include failure of the systems to recognize unequipped trains and/or trains with failed equipment in non-signaled territory, coupled with the possibility of excessive crew reliance on the expected warning (vs. normal attention to compliance with written directives).

Conventional Systems

Conventional train control systems include automatic cab signals, automatic trainstop and automatic train control systems whose functionalities are identified in Section III. A. above. These systems require the support of wayside block signal systems.

Block signals are already installed on 68,284 road miles (86,832 track miles) of the Nation's rail network. Automatic cab signal, trainstop or train control systems exist on 6,118 road miles (10,739 track miles) of the block signal systems - 8.9 percent of the road miles and 12.3 percent of the track miles. The preponderance of the block signal systems are installed on lines having moderate to high train density, as are the cab signal, trainstop and train control systems. Automatic train control systems are installed on lines having high density, high speed traffic. For more than 70 years, the safest rail corridors with regard to train collisions have existed between Chicago, Illinois and Council Bluffs, Iowa and between Richmond and Alexandria, Virginia, where automatic train control was installed in 1926.

By the mid 1940s, 17 percent of the road miles in the Nation's rail network was equipped with conventional train control systems as a result of a 1906 Congressional mandate to study the need for the systems and subsequent legislation that empowered the Interstate Commerce Commission to compel railroads to install the systems where found necessary in the public interest. However, post WWII downsizing of the railroads resulted in discontinuance of several thousand miles of conventional train control systems with little or no intervention from the Federal sector. Only one railroad, the Union Pacific, continued to expand its automatic cab signal system, mainly for the economic benefits gained in the efficiency of train movements. The expansion of cab signals on the UP was terminated in the 1980s as a result of mergers and interest in PTC.

The technology of automatic train control has shown that both business and safety benefits can be achieved through its utilization. The equipment is readily available off-the-shelf for incremental expansion in connection with signal system installations or rehabilitations at less cost than PTC.

Innovative developments

The irregular hours worked by train crew members and the environments of the locomotive cab exacerbate employee fatigue and inattention. Audible devices associated with automatic cab signal, automatic train stop and automatic train control systems, overspeed devices and deadman pedals have long been used to draw attention of the locomotive engineer to the need to take appropriate actions. Absent such systems or devices, other means are under consideration for alleviating these human factor qualities.

Alertness Devices

Several companies manufacture alertness devices designed to combat fatigue and inattentiveness. Essentially, the alertness devices are arranged to periodically display a visual and audible alarm that requires acknowledgment to prevent an application of the brakes until the train is brought to a stop. Various means are employed to minimize annoying distractions of the alertness devices, including use of the body's capacitance effect to detect recurring movement of the locomotive engineer that constrains warnings and less frequent warnings at lower speeds than at higher speeds.

Amtrak utilizes alertness devices on all controlling locomotives. However, alertness devices have not found favor on all freight railroads. Alertness devices are potentially capable of reducing human factor related inactions considered to be causal factors in certain types of accidents. However, studies strongly indicate that alertness device alarms, like those associated with other

systems, may be acknowledged during periods of microsleep induced as a result of fatigue with resultant contributory inactions.

Positive Signal Comparator

Failure to comply with signal indications and speed requirements has a long history as contributing factors to accident/incidents. Quantum Engineering, Inc. is pursuing the development of a device identified as the Positive Signal Comparator (PSC) to combat these causal factors.

Features of the PSC include an on board computer (OBC) containing a track database, block signal aspects and indications database, GPS for location determination with an accuracy of +/- 300 feet, a conductor's display and an engineer's display. The PSC is turned on and programmed by train crew members utilizing buttons provided on the displays. The PSC does not receive inputs from the wayside.

Unless programmed with the train length and the appropriate speeds, the PSC will limit a train movement to not exceeding 15 miles per hour. Once programmed with the appropriate speed requirements, including temporary speed restrictions, the PSC will enforce the speeds and provide warnings 1000 feet in approach to each signal location or point where speed is to be reduced.

At signal locations, acknowledgment of the signal indication must be made within 25 seconds after reaching zero feet in order to forestall an application of the brakes until the train is brought to a stop. Both the conductor and engineer must enter signal aspects that agree in order to forestall an application of the brakes until the train is brought to a stop. The PSC will enforce a speed of 40 miles per hour for signals displaying an aspect indicating Approach and 35 miles per hour for signals displaying aspects indicating Diverging Clear, Diverging Approach Diverging, Diverging Approach Medium, and Diverging Approach.. At a Restricting signal and after a Stop and Proceed signal, 20 miles per hour is enforced. Zero speed is enforced at signals displaying aspects indicating Stop and Stop and Proceed. The length of the train is enforced during diverging movements. All other signal aspects are enforced at the maximum authorized speed.

At points where speed is to be reduced, the engineer must acknowledge and the appropriate speed be attained to prevent an application of the brakes until the train is brought to a stop. Pressing the enter key will cancel the restriction once the train is clear. At maintenance-of-way work zones requiring a stop, the engineer must press the enter key at the Yellow/Red flag and the PSC will count down two miles where zero speed must be obtained to prevent enforcement. Pressing the cancel key will change the restriction to 20 miles per hour and pressing the cancel key again will cancel the work zone restriction.

The PSC has the potential, if properly used, to reduce human factors actions that contribute to accident/incidents resulting from failure to comply with signal indications and overspeed. A significant deficiency in the PSC is lack of input to and from the wayside or control office that would assure the system is properly programmed and used.